

## Effect of Smart Phone Use on Dynamic Postural Balance

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**Abstract.** [Purpose] The present study investigated what kind of effect smart phone use has on dynamic postural balance. [Subjects] The study subjects were 30 healthy students in their 20's who were recruited from a University in Busan, Korea. [Methods] The present experiment was quasi-experimental research which measured the postural balance (BiodeX) of subjects while they sent text messages via smart phones in the standing position with the eyes open, and while they used two-way SNS. [Results] There were significant differences between standing and the dual-task situations. Among dual tasks using smart phones, SNS using situations showed the highest instability. [Conclusion] The use of smart phones in less stable conditions such as while walking or in moving vehicles should be discouraged.

**Key words:** Smart phone, Dual task, Balance

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### INTRODUCTION

Smart phones are one of the devices that modern people use the most. As of Jan. 2013, there are more than 33 million smart phone users in Korea. It is the most generalized generally used electrical device<sup>1)</sup>. A smart phone is a mobile phone with various functions of in addition to the traditional a computer, and it enables use of many social networking services like such as Twitter and Facebook functions of calling and texting. It requires more concentration than a traditional mobile phone.

Smart phones have already become a part of our daily lives and they offer us many conveniences, but like all the other modern conveniences, their negative effects on our life should not be overlooked. One of the most serious consequences of smart phone use is that it is habit-forming. That means when people don't use a smart phone, they feel nervous and they become physiologically dependent on them, habitually depending on their smart phone<sup>2)</sup>. Chang min Seo et al.<sup>3)</sup> defined "Smart phone addiction as being immersed in smart phone use with no self-control, resulting in harmful consequences for self and others". According to one study of smart phone use among young people, average daily use during weekdays was 5.1 h and 5.9 h during weekend. It means that young people use smart phones considerably in their daily routine, and most of that use was chat messanges<sup>4)</sup>.

Despite various downsides of smart phone use, unlike its convenient aspects, studies of its negative effects have not yet been conducted. Most studies have investigated the psychological harm of smart phone addiction. Smart phones, the electrical device that people use the most in their daily lives, also offers SNS services such as video clips, and mobile net surfing. According to the Korea Internet & Security Agency<sup>5)</sup>, people use smart phones the most when they're waiting on something, or when they're in moving vehicle. Dual task situations, such as smart phone use while standing in a moving vehicle, can be a posture-threatening factor similar to reading a newspaper while standing on an unstable base. However, few studies have investigated this aspect of smart phone use. Therefore, the present study examined what kind of effect smart phone use has on dynamic postural balance.

### SUBJECTS AND METHODS

The study subjects were 30 healthy students attending C University who were in their 20s. Subjects who had vestibular problems, reported dizziness, or had difficulty with standing balance due to ankle or knee pain or injury were excluded from the experiment. All subjects received sufficient explanation about the study, and they voluntarily participated in the study. Approval for this study was obtained from the Ethical Committee of the Catholic University of Pusan.

The present experiment was quasi-experimental research which measured postural balance with the eyes open while sending text messages via a smart phone, and while using two-way SNS. The subjects were measured on a BiodeX (BiodeX Medical Systems, Inc., USA) the postural balance measuring system. BiodeX has high validity between

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measurers and in measuring body postural balance<sup>6)</sup>.

Balance was measured with the eyes open in the following situations: in the standing position, while sending text message from a smart phone, and while using SNS on smart phone. Subjects adopted a natural two-legged standing position in all of the situations. Dynamic postural stability measures can vary depending on the adjustment level of the Biomedex platform. Shaking of the platform is the most on the 1st stage which has the highest instability, and the shaking is the least in the 8th stage which has the highest stability. In the present study, 7th stage was utilized, because we considered it was most suited to the tasks on the basis of a pilot study. The measurement time was 30 seconds per trial, and 3 trials were performed, from which the mean value was calculated. The situations for measurement were randomly selected and there was 1 hour of break time between measurement of each situation to minimize learning effects.

Subjects were told to send the 1st couplet of the Korean national anthem to a designated evaluator for sending a text message with two a smart phone. For SNS, KakaoTalk, the most popular two-way messenger in Korea, was used to conduct ‘text exchanges’ via a smart phone. For this SNS situation, two friends of the subjects were pre-selected to ensure the subject had a natural conversation with his/her friends. Questions asked of subjects via smart phone SNS were required to have instant and short answers. For example, the two friends were told to ask questions like “What did you eat for breakfast?”, “What color of pants or shirt are you wearing now?” and they were told to conduct as much conversation as possible.

One-way ANOVA of the SPSS 18.0 program was used for statistical analysis to determine the significance of changes in postural balance with situation, and Duncan’s test was conducted for post-hoc analysis. Statistical significance was accepted for values of  $p<0.05$ .

## RESULTS

The general characteristics of the subjects are shown in Table 1. The Stability Index (SI) which is a measure of postural sway was used to represent postural balance. A higher SI index indicates greater postural sway and a lower index indicates higher stability with less postural sway. The SI index has three components OSI (overall SI), represents total postural sway; APSI (anteroposterior SI), represents anteroposterior postural sway and MLSI (mediolateral SI), represents mediolateral postural sway. There were significant differences among all of the situation for each of the components of the SI index (Table 2).

## DISCUSSION

The present study was conducted to identify effect of dual task, smart phone use, on dynamic postural balance. In both the text message sending and SNS chat messaging situations, decrease of overall dynamic balance ability was found. OSI (which represents overall balancing ability) of standing with the eyes open was 2.42, but it was 3.99 in the text message sending situation, a significant increase in instability. The SNS service using situation resulted in the

**Table 1.** Characteristics of the subjects (N=30)

Description	healthy subjects
Gender (M/F)	15/15
Age (y)	22.0 (2.3)
Height (cm)	168.4 (9.0)
Weight (kg)	61.2 (10.3)

Values are Means  $\pm$  SD

**Table 2.** Comparison of dynamic balance (N=30)

Situation	Standing	Message	SNS
OSI *	2.42 $\pm$ .20 <sup>a</sup>	3.99 $\pm$ 1.29 <sup>b</sup>	4.98 $\pm$ 2.14 <sup>b</sup>
APSI *	1.94 $\pm$ 0.76 <sup>a</sup>	3.64 $\pm$ 1.42 <sup>b</sup>	4.14 $\pm$ 1.75 <sup>b</sup>
MLSI *	1.60 $\pm$ 0.46 <sup>a</sup>	2.38 $\pm$ 1.07 <sup>a</sup>	2.80 $\pm$ 1.49 <sup>b</sup>

SNS: Social network service, osi: overall stability index, APSI: Anteroposterior stability index, MLSI: Mediolateral stability index

Values are Means  $\pm$  SD

\*  $p<0.05$  significant difference between group

greatest instability, an OSI of 4.98. For APSI (which represents anteroposterior balance in the sagittal plane), the index was 1.94 in standing with the eyes open, but was 3.64 in text sending, a significant increase in instability. The index was 4.14 in the SNS showed the greatest instability.

For MLSI (which represents mediolateral balance in the coronal plane), the index was 1.60 in the standing with eyes open, and was 2.38 in text sending, an increase that was not significant. However, the index was 2.80 in the SNS using situation, a significant increase in instability.

Rahnama<sup>7)</sup>, however, reported there were no significant differences in OSI, APSI or MLSI of normal subjects in a dual task (backward digit span task: e.g. the researcher orally gave a list of random numbers, say 3-5-7-1-2-3-6, and subjects had to repeat them in reverse order, 6-3-2-1-7-5-3).

We consider that the dual task of smart phone use in the present study was more difficult than Rahnama’s dual task: thus, it could have been more difficult to maintain balance under the dual task conditions of our present study.

To sum up, subjects showed the highest instability under the dual task condition of smart phone SNS use. This result can be understood as meaning that SNS requires more concentration than texting. Compared to the texting service of traditional mobile phones, smart phone SNS enables people to have conversation with many people at the same time, which is better than a one-to-one text sending function. In addition to that, smart phones also offer exchange of various information through pictures, video and internet news delivery etc. That is, smart phone SNS help people to form networks anytime and anywhere they want, regardless of time and space, realizing social relationships in a mobile on-line environment which was previously realized at static computer terminals. On the other hand, smart phone use requires significant concentration.

Smart phones can be used anytime and anywhere in our life because they’re easy to carry and use, but they can have

negative effects on walking. In the recent study of Eric and Lisa<sup>8)</sup>, it was reported that the use of a mobile phone during gait decreased walking speed by 33%, and they also reported that the use of a mobile phone increases lateral deviation during gait by 61% due to a decrease in concentration. This result is in agreement with the results of the present study which showed a decrease in dynamic balance ability when subjects use text messages.

The ability to maintain upright standing position is the most basic skill required for gait and other dynamic behaviors<sup>9)</sup>. However, in the present study, we found that the use of a smart phone can increase the instability of dynamic postural balance. Therefore, use of a smart phone in situations such as while walking or in a moving vehicle should be discouraged.

## REFERENCES

- 1) Korea Internet & Security Agency: 2012 Survey On the Smartphone Usage. Korea Communications Commission.
- 2) Kim BN, Choi HI: Effects of study over protective parent's raising attitude on university student's smartphone-addiction: the mediating effects of self-control. *Soc Sci Res Rev*, 2013, 29: 1–25.
- 3) Seo CM, Lee JH, Choi TY, et al.: Study for relations between smart-phone addiction level and Korea youth self report. *J Korean Soc Biol Ther Psychiatry*, 2012, 18: 233–30.
- 4) Korean Speech & Communication Association: Usage and Addiction Youth Survey smartphones. <http://www.dbpia.co.kr/Article/3191079> (Accessed Jun. 2013)
- 5) Korea Internet & Security Agency: 2011 Survey On the smartphone Usage. Korea Communications Commission.
- 6) Sherafat S, Salavati M, Ebrahimi Takamjani I, et al.: Intrasession and intersession reliability of postural control in participants with and without nonspecific low back pain using the Biodesk Balance System. *J Manipulative Physiol Ther*, 2013, 36: 111–118. [Medline] [CrossRef]
- 7) Rahnama L, Salavati M, Akhbbari B, et al.: Attentional demands and postural control in athletes with and without functional ankle instability. *J Orthop Sports Phys Ther*, 2010, 40: 180–187. [Medline] [CrossRef]
- 8) Lamberg EM, Muratori LM: Cell phones change the way we walk. *Gait Posture*, 2012, 35: 688–690. [Medline] [CrossRef]
- 9) Vaillancourt DE, Newell KM: Changing complexity in human behavior and physiology through aging and disease. *Neurobiol Aging*, 2002, 23: 1–11. [Medline] [CrossRef]